

# Gibbons Creek Annual Data Summary

## Part 1 –Effectiveness and Trend Monitoring by Volunteers

June 2005

### Background

Gibbons Creek is located in eastern Clark County and flows into the Columbia River just east of the town of Washougal (Figure 1).

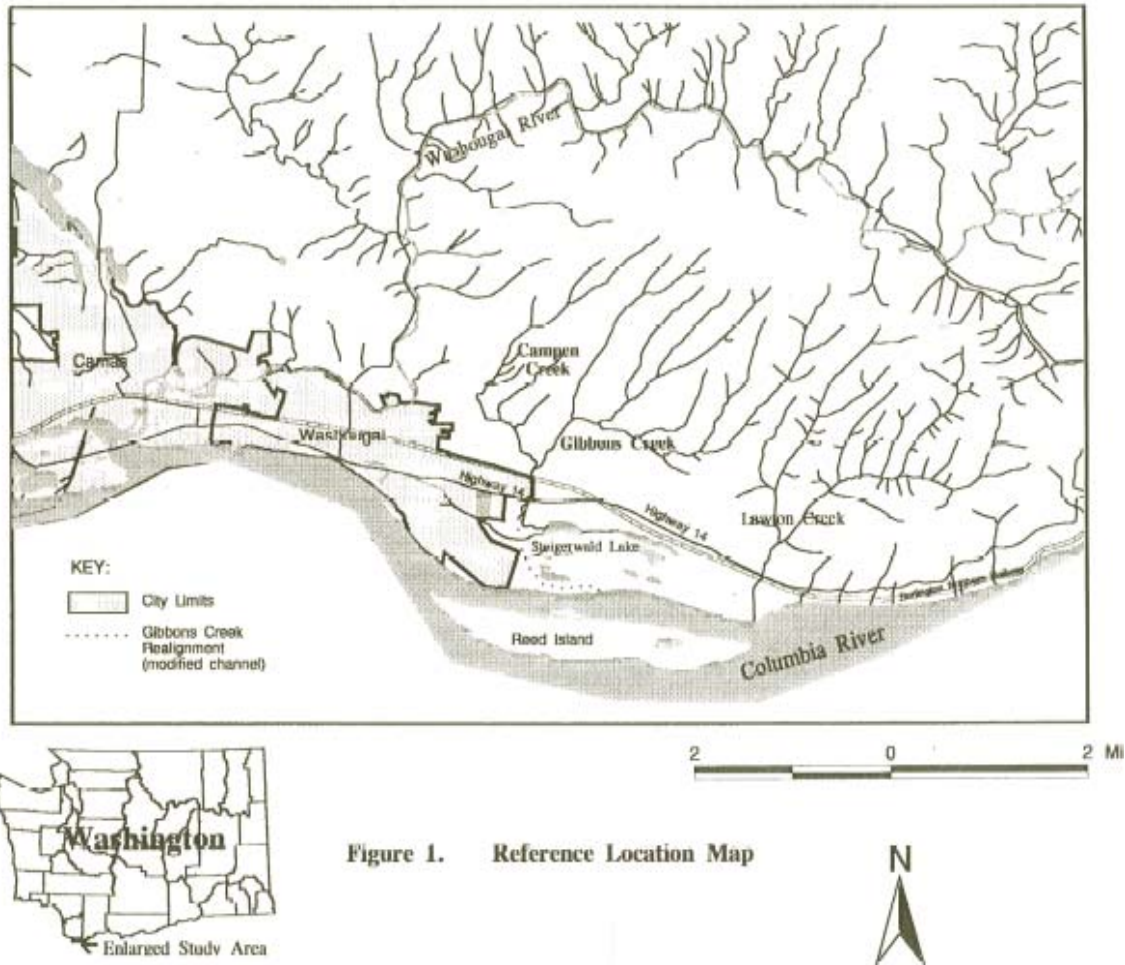


Figure 1. Reference Location Map

Figure 1. Map of Gibbons Creek and vicinity.

Land use in the watershed consists largely of rural residential development along the slopes of the Columbia River Valley. Many of these residences keep a small number of horses and/or cattle. The eastern fringe of the town of Washougal extends into the western portion of the watershed encompassing most of Campen Creek, including a school, golf course, and new residential development. Part of the area is serviced by city sewer, but the city plans to service all residents.

Gibbons Creek is classified as Class A for water quality standards and therefore shall meet or exceed the requirements for all or substantially all of the following characteristic uses: domestic, industrial, and

agricultural water supply; stock watering; salmonid and other fish migration, rearing, spawning, and harvesting; clam, oyster, and mussel rearing, spawning, and harvesting (Ch. 173-201A WAC). Water quality data for the Gibbons Creek watershed primarily consist of those measured by Ecology's Ambient Monitoring Program (Ehinger, 1993; unpublished data 2002) those from the TMDL assessment (Nocon and Erickson, 1996), and data collected by the U.S. Fish & Wildlife Service (USFWS, 2003). Historical fecal coliform data is summarized in Table 1 below.

Table 1. Summary of fecal coliform data from previous Ecology monitoring programs.

Monitoring Station	Monitoring Date Range	Range of Fecal Coliform Concentrations	Geometric Mean Fecal Coliform Concentration	90 <sup>th</sup> Percentile Fecal Coliform Concentration
Gibbons Creek at Evergreen Highway (Ecology ID 28G070)	October 1991-September 1992	37-900 cfu/100mL	230 cfu/100mL	705 cfu/100mL
Gibbons Creek at Evergreen Highway (Ecology ID 28G070)	October 2001-September 2002	6-1300 cfu/100mL	119 cfu/100mL	635 cfu/100mL
Campen Creek mouth above confluence (Ecology ID 28H070)	October 2001-September 2002	12-1200 cfu/100mL	158 cfu/100mL	1052 cfu/100mL

## Project Methods

Under the TMDL requirements of the federal Clean Water Act, monitoring is required to track the effectiveness of implementation activities and to determine if pollution reduction targets are being met. To meet this requirement, monitoring will be conducted in the Gibbons Creek watershed in three parts. The purpose of dividing the monitoring is to increase public participation, spread monitoring costs among monitoring participants, and provide adequate data to determine the effectiveness of implementation activities. This division of responsibility also closely follows areas of expertise of the participants.

Part 1 of the study, carried out by Clark County and City of Washougal Wastewater Treatment plant staff, and by trained volunteer monitors, has the following objectives:

- Initiate preliminary source identification.
- Track relative contribution (loading) of various tributaries in the watershed.
- Involve community in water cleanup planning and monitoring.
- Determine effectiveness of implementation activities on water quality.

The monitoring surveys include seven survey locations sampled at approximately monthly intervals for bacteria and turbidity (Figure 2 map). Water temperature is monitored continuously during the summer months at using data loggers. The study design is intended to provide data representing seasonal variations and weather conditions. Methods for individual parameters are shown in Table 2.

Table 2. Methods for field measurements and lab parameters.

Field Activity Type	Sampling Frequency	Method	Equipment	Sample Size	Container Preservation	Holding Time
Fecal Coliform	Monthly	Standard Methods (SM) 9222D Membrane Filtration	NA	100-mL	250-mL sterile HDPE	30 hours
Turbidity	Monthly	EPA 180.1 Nephelometric	Hach 2100P	10-mL	15-mL glass vial	48 hours
Temperature	Continuous 1-hr interval	EPA 170.1	Hobo Water Temp Pro datalogger	NA	NA	NA

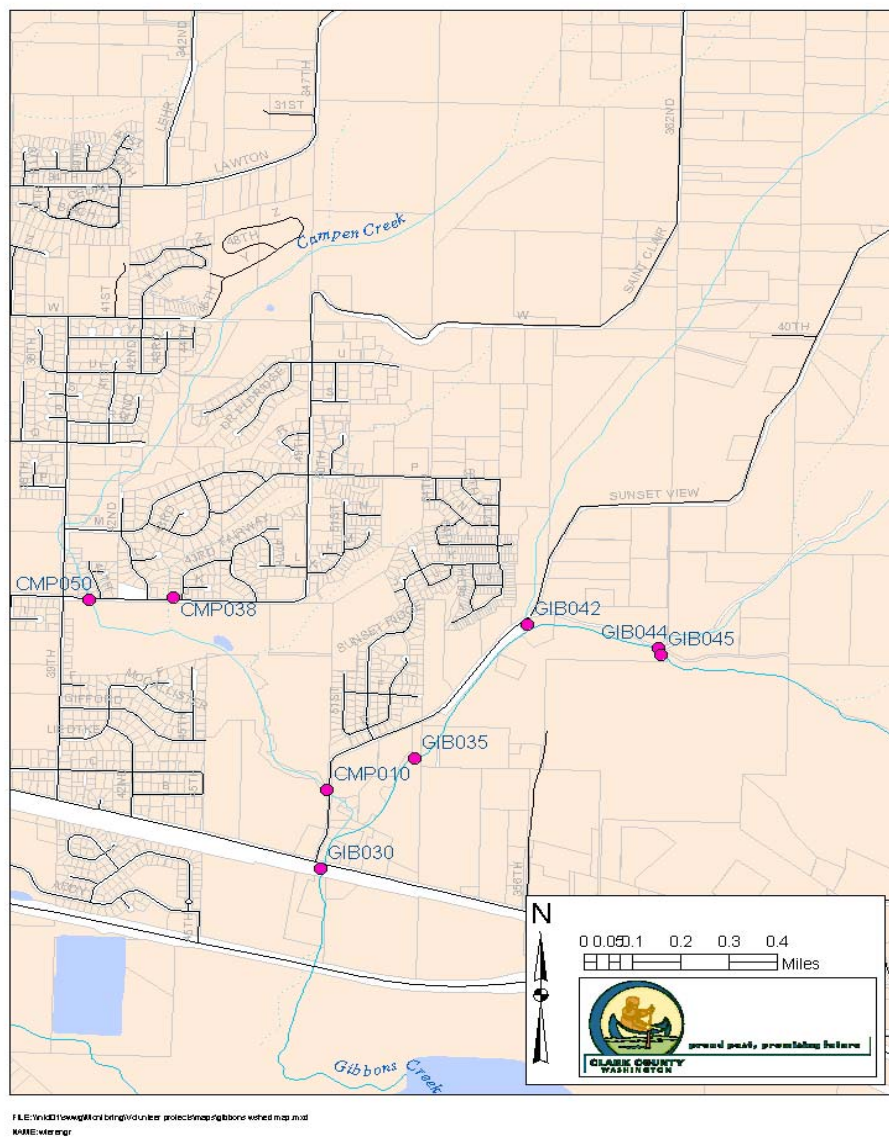


Figure 2. Map showing the layout of volunteer monitoring stations.

Water Resources staff conducted the first monitoring survey in April 2004. A volunteer training event was held for six volunteers in May 2004. Additionally, trained volunteers instructed other volunteers that later joined the project. The volunteers were trained to follow a general flow of sampling procedures. Monitoring dates were arranged by teams of two or three people and confirmed with county staff to ensure equipment availability. Volunteers reported to the Washougal WWTP to pick up field equipment kits. Typically the Gibbons Creek sample sites were visited first, followed by Campen Creek sample sites.

The site name, sample date, and time uniquely identified the samples collected by volunteers. Unique sample bottle identification numbers were assigned by the lab. Volunteers recorded on the field data sheet the identification number of the sample bottle for the specific site sampled. The lab tracked bacteria samples and data by the sample bottle number. Prior to sampling, arrangements were made with the lab to drop off water samples, allowing sufficient time to analyze them within holding-time requirements. Arrangements needed to be made for staff to work according to volunteer's schedules, which often included weekends.

## Data Summary

A fecal coliform data summary is presented in Table 3 and in Figure 3 below. Water quality criteria for a Class A water body in Washington State maintain that “fecal coliform organism levels shall both not exceed a geometric mean value of 100 colonies/100 mL, and not have more than 10 percent of all samples obtained for calculating the geometric mean value exceeding 200 colonies/100 mL”.

Most of the monitoring stations in Gibbons Creek violate one or both of the criteria. Specifically, five of the seven stations violate both criteria. The two sites satisfying both criteria were the stations representing the upper watershed, GIB044, located at the Wooding Road tributary, and GIB045, the upstream-most sample station on Gibbons Creek. The monitoring stations on the mainstem Campen Creek, located at the creek's mouth and above the golf course, had geometric mean concentrations nearly three times the criterion level. The upper-most sample station on Campen Creek had the highest 90<sup>th</sup> percentile value of all the stations at nearly five times the water quality criterion of 200 cfu/100mL.

Table 3. Summary of fecal coliform sample data from April 2004 to April 2005; highlighted values fail the state criterion.

Monitoring Station Code	Number of Samples	Range of Fecal Coliform Concentrations cfu/100 mL	Geometric Mean Fecal Coliform Concentration cfu/100 mL	90 <sup>th</sup> Percentile Fecal Coliform Concentration cfu/100 mL
CMP010	10	120-2420	307	629
CMP038	11	2-2120	118	336
CMP050	11	40-1030	292	980
GIB030	11	30-580	126	302
GIB042	10	20-700	102	327
GIB044	10	3-160	32	101
GIB045	10	2-206	39	147

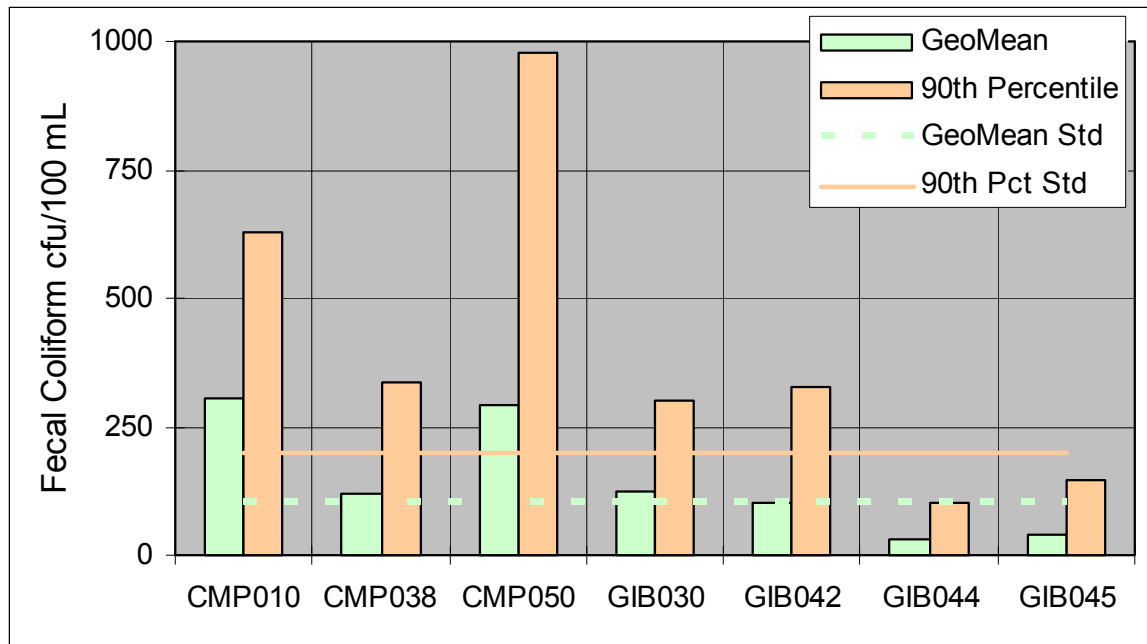


Figure 3. Summary of fecal coliform data from April 2004 to April 2005. Geometric mean (GeoMean) concentrations and 90<sup>th</sup> percentile concentrations are shown as bars. The standard lines show the Washington State Class A water quality criteria for each measurement.

Time series for fecal coliform are shown below in Figure 4. The figure shows that high fecal coliform levels occur in sharp peaks, most likely driven by storm events. The GIB042 site, located on a tributary running along Sunset View Road, had consistently elevated bacteria levels through out the spring and summer, and also during rain events. Campen Creek had consistently high bacteria levels that were dramatically higher during rain events.

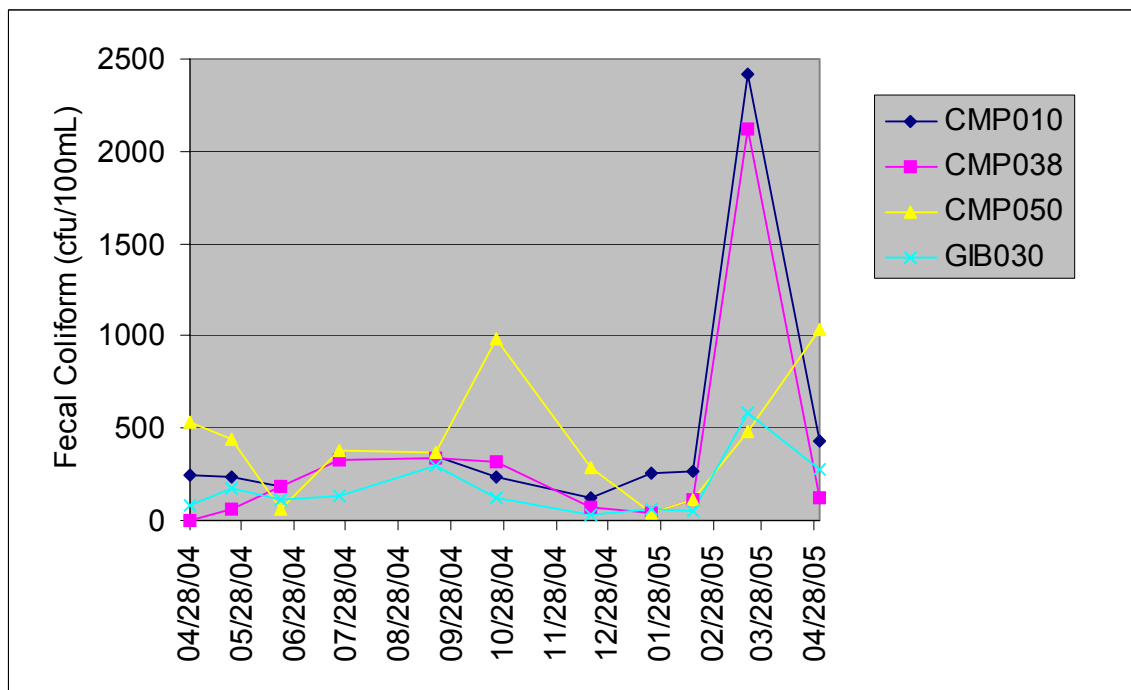
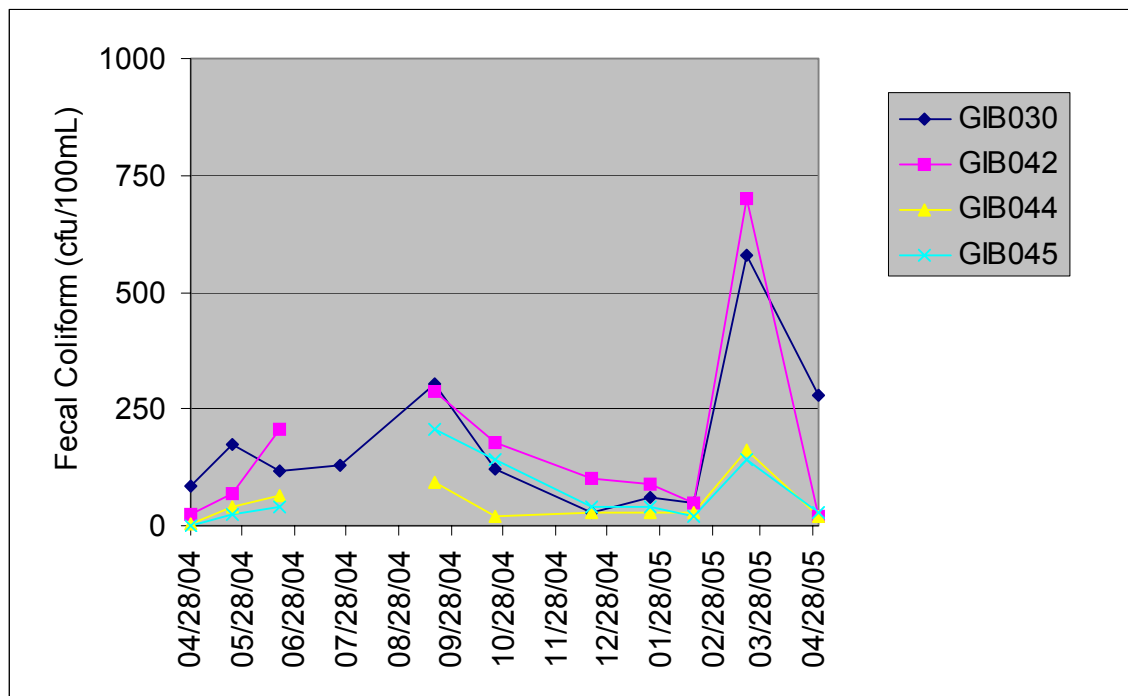


Figure 4. Time series data for fecal coliform separated into the Gibbons Creek monitoring stations (above) and the Campen Creek monitoring stations (below), April 2004 to April 2005.

Turbidity values are summarized in Table 4 below. Typically the observed values were low; for example the median value at each of the monitoring stations was below 10 NTU. Median values are better indicators of central tendency than mean for data that is skewed with more low values than high values. Occasionally, very high values of turbidity were noted at each of the monitoring stations. Average values shown in Table 4 are influenced by these occasionally high values.

Water quality criteria for a Class A water body in Washington State maintain that “Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU”. Although background turbidity for the creeks has not been determined it is most likely similar to the lower range of values observed at the sample stations, particularly the upper most stations. A background turbidity less than 5 NTU is realistic.

Table 4. Summary of turbidity sample data from April 2004 to April 2005.

Monitoring Station Code	Number of Samples	Range of Turbidity Values	Average Turbidity NTU
CMP010	11	3.9-81.4	19.3
CMP038	12	3.9-337	36.8
CMP050	12	3.4-92.4	17.5
GIB030	12	2.5-96.8	14.8
GIB042	11	3.2-95.4	21.6
GIB044	11	4.2-63.9	12.0
GIB045	11	2.5-103	16.4

Time series for turbidity levels are shown below in Figure 5. Sharp increases in turbidity were noted during rain events at each of the stations. The highest turbidity was observed at the GIB042 tributary and the CMP038 tributary in the Gibbons and Campen Creek drainages, respectively.

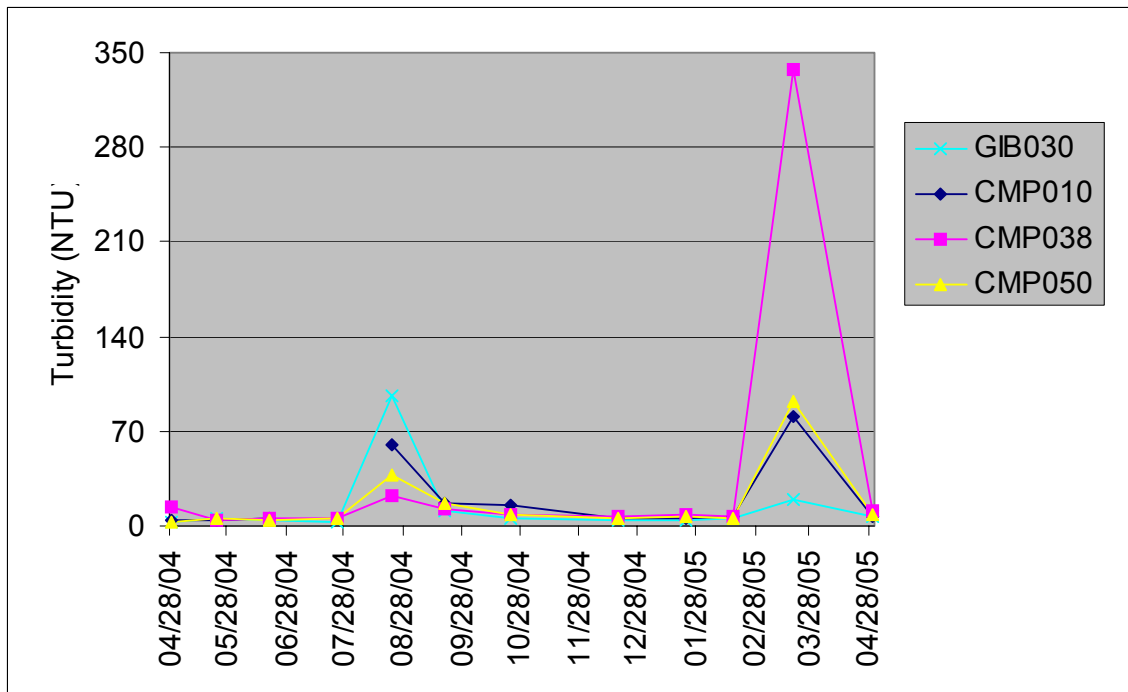
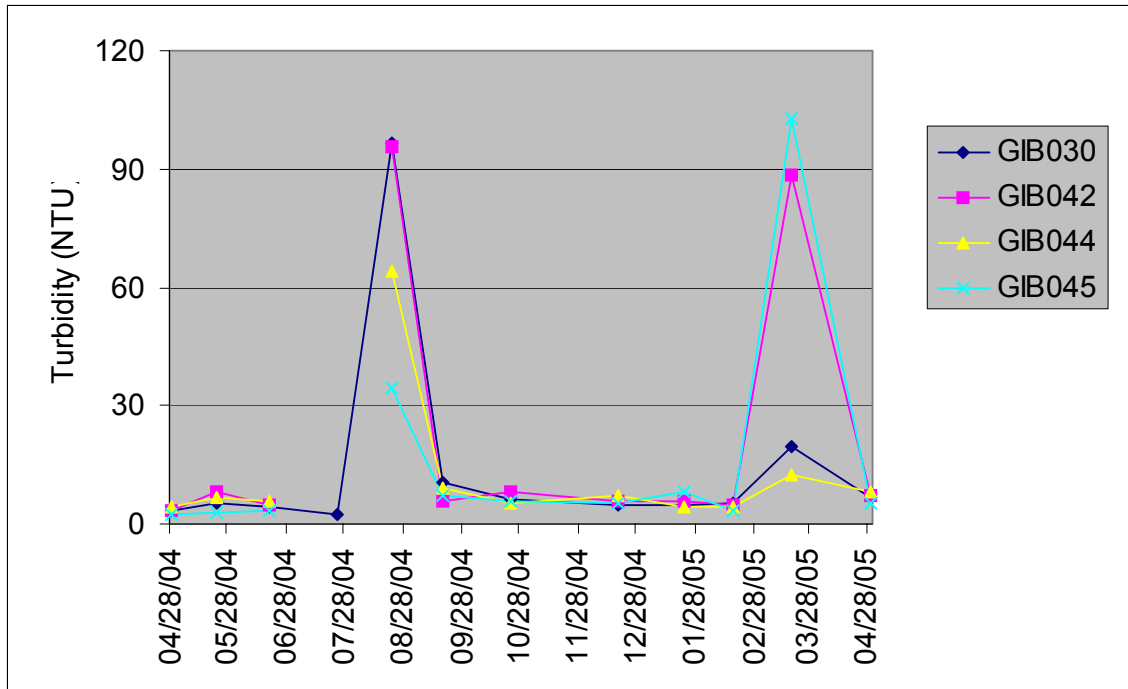


Figure 5. Time series data for turbidity separated into the Gibbons Creek monitoring stations (above) and the Campen Creek monitoring stations (below), April 2004 to April 2005.

Water temperature statistics calculated from the continuous data logger records are shown in Figure 6. Data loggers were not deployed at all of the stations. Water quality criteria for a Class A water body in Washington State maintain that “Temperature shall not exceed 64.4 deg-F (freshwater) or 60.8 deg-F (marine water) due to human activities”. The main stem Gibbons Creek tributary stations were close to the 64.4 deg-F standard, while the other main stem sites were 3-5 degrees above the standard.

The GIB010 station, located at the mouth of Gibbons Creek at the Columbia River, was established for a cooperative project with the US Fish and Wildlife Service. Maximum water temperature at the GIB010 site was much higher than the other stations. Prior to 1992, the lower reach of Gibbons Creek flowed westerly for the lower mile before discharging into the Columbia River. Since 1992, this channel has been significantly modified and it drains nearly due south from the highway crossing, through the Steigerwald Lake Wildlife Refuge, to the Columbia River. For most of this lower mile, the creek flows through an artificial, elevated channel before discharging into the Columbia River through a fish ladder structure. Because this portion of the channel is elevated (built on a dike), the surrounding land does not drain into Gibbons Creek, but instead drains into the old remnant channel. Therefore, no land south of Highway 14, including the wildlife refuge, industrial park, and agricultural areas contributes runoff to Gibbons Creek

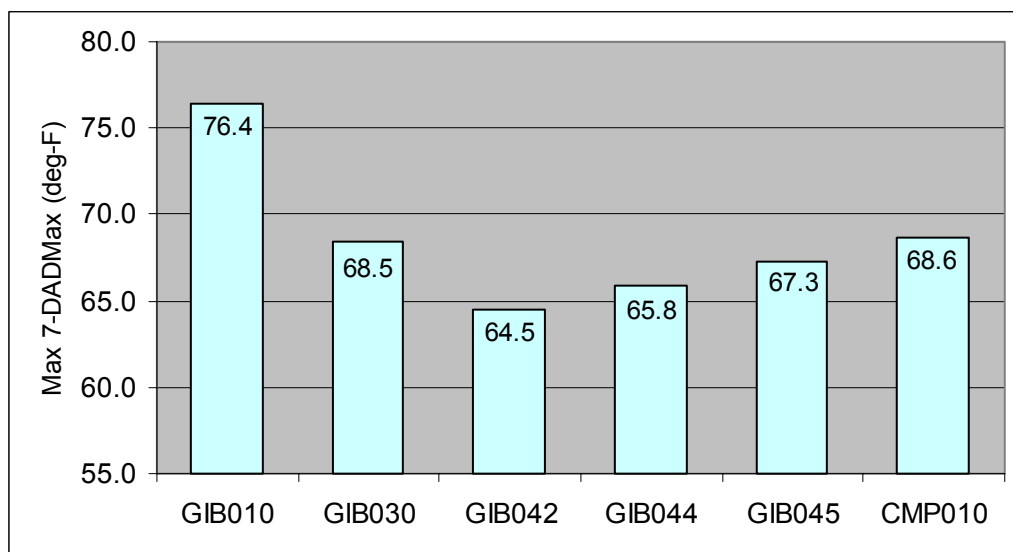


Figure 6. Water temperature data statistics for the Gibbons Creek watershed. Data reported is the maximum 7-day moving average of the daily maximum (Max 7-DADMax) water temperature.

## Quality Control

### *Data completeness*

There were thirteen sampling events scheduled from April 2004 to April 2005. The turbidity data was over 90% complete with 12 out of 13 events sampled. Fecal coliform data had about 80% completeness. In July, the fecal coliform and turbidity data for half of the sites was discarded due to uncertainty from a mix-up of sample bottle numbers. During a rainstorm in August 2004, although field measurements were recorded, all fecal coliform lab results were either “fouled” or “too numerous to count” and were therefore unusable. In November 2004 no sampling was completed due to a schedule mix-up between the volunteer team and the lab.

Water temperature data loggers were deployed at five of the seven sample sites for about 70% completeness. Loggers were not deployed in the upper Campen Creek tributaries because no secure data logger locations were found. In early 2005 volunteers were equipped with a handheld temperature probe to collect temperature data during grab sampling events. An additional data logger was deployed at the mouth of Gibbons Creek outside the project area in cooperation with the US Fish and Wildlife Service.

#### *Quality Control Results*

This project's QC sample types, frequencies, and definitions are listed in Table 5. Fecal coliform samples and field meter measurements were duplicated at one sample site during each monthly survey.

Table 5. QC sample types, frequencies, and definitions required for the project.

QC Sample Type	Frequency	Definition
Field measurement replicate	One per monthly survey	Repeat field meter measurements
Sample duplicate	One per monthly survey	Duplicate sample collected for laboratory analysis

All meters were calibrated and maintained by Water Resources staff in accordance with the manufacturer's instructions. Secondary standards for turbidity were used to verify the calibration of field meters. An NIST-certified thermometer was used to verify the accuracy of temperature sensors. Calibration logs were completed during each calibration and were archived in Water Resources files.

Laboratory QC samples were analyzed in accordance with the Washougal Wastewater Treatment Plant Laboratory's Quality Assurance plan. Other than results from sample blanks there was no information furnished from the lab with the data reports.

Eleven duplicate pairs of samples were collected for fecal coliform analysis. The data quality objective for fecal coliform duplicate samples was 25% RSD on log-transformed data (Table 6). Ten of the eleven QC samples met this objective and the majority of the duplicate sample data was quite good. A single pair resulted in a log transformed RSD of 33%, however, the result did not appear to be related to an ongoing problem.

Table 6. Summary Measurement Quality Objectives (MQO's) of laboratory and field parameters.

Parameter	Accuracy	Precision	Bias	Required Reporting Limit
	<i>Percent (%) deviation from true value or units of measurement</i>	<i>Relative Standard Deviation</i>	<i>Percent (%) of true value</i>	<i>Concentration units</i>
Turbidity	25%	10%	5%	1 NTU
Fecal Coliform	NA	25% (log transformed data)	NA	2 MPN/100mL

Nine turbidity measurements were replicated in the field by the volunteer teams. During a few sampling events near the beginning of the program volunteers did not collect QC replicate measurements for turbidity. The data quality objective for the replicate turbidity measurements was an RSD of 10%. Eight of the nine QC measurements met the objective and one measurement had an RSD of 14%, but the result was near the lower end of the method reporting limit and was actually only a 0.5 NTU difference. In general the turbidity QC data was also good.

### **Modifications for 2<sup>nd</sup> Year of Monitoring**

1. Increase data completeness.
  - Better communication between staff and volunteers.
  - Contingency plan to use a commercial lab when the Washougal WWTP lab is unavailable.
  - Modify lab methods to technique for turbid samples to reduce the likelihood of fouled samples (implemented in 2004).
2. Hold another volunteer training event in 2005.
3. Identify flow monitoring opportunities.

## **Acknowledgements**

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[www.clark.wa.gov/water-resources/index.html](http://www.clark.wa.gov/water-resources/index.html)

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